SPACE SHUTTLE

Solid Rocket Motors
Morton Thiokol, Inc.

TWR- 18169

Structural Analaysis of Flap Bulb Terminus Separation

27 February 1989

Prepared for:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
MARSHALL SPACE FLIGHT CENTER, ALABAMA 35812

Contract No.	NAS8-~~30940~~ 30490
DR. No.	3-5
WBS.No.	HQ301

MORTON THIOKOL, INC.

Aerospace Group

Space Operations

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FORM TC 4677 (REV 1-88)

(NASA-CR-183708) STRUCTURAL ANALYSIS OF FLAP BULB TERMINUS SEPARATION (Morton Thiokol) 28 p

N89-71307

Unclas

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DOC NO. TWR-18169 VOL REV

TITLE

STRUCTURAL ANALYSIS OF FLAP BULB TERMINUS SEPARATION (DR-123522)

March 1989

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SS-3163

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1.0 INTRODUCTION

There is a separation in front of the flap gap terminus on 1U 75428-02 SN 0000001 (see Figure 1). The separation begins 1.2 inches on the clevis side of the flap gap terminus hereafter known as terminus, and measures 2.6 inches longitudinally by 7.33 inches circumferentially. This separation is defined by Discrepancy Report (DR) 123522 (see Appendix A). It has been assumed that the separation occurred in the insulation during layup by either air or some foreign material. The layup is the most likely cause of the separation and is the worst case scenario.

The separation has been included in a two dimensional axisymmetric model of the center segment, thus, assuming the separation is full circumference; a worse case scenario rather than the actual condition. An assumption was made that the separation does not violate the tie ply (see Figure 1). As discussed subsequently, several finite element analyses were performed using Thiokol Automated Stress System (TASS) to estimate:

1) The potential for separation growth.
2) Any additional stresses in the segment if the flap gap were to be potted with an adhesive that would prevent gas flowing to the flap gap terminus during pressurization.
3) The flap gap opening for the different slump conditions to determine ease of potting.

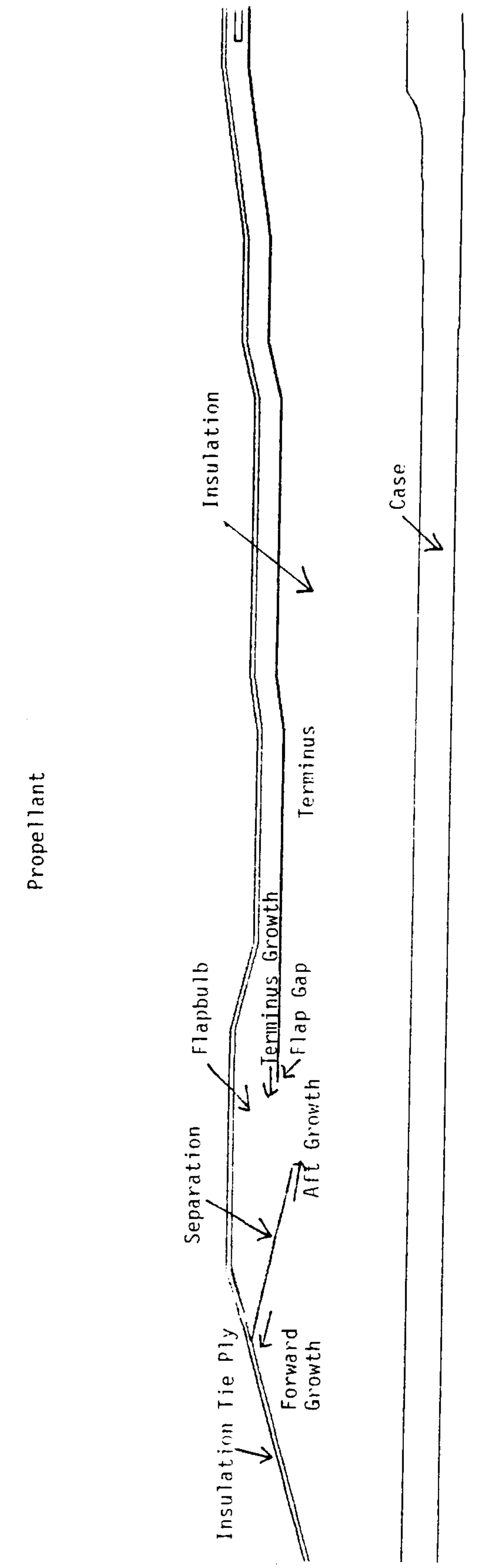


Figure 1
Flapbulb with the Position of the Separation in DR-123522

2.0 SUMMARY

To determine the potential for separation growth, the separation was analyzed using fracture mechanics. Typical stress and strain failure criteria cannot be used since separation terminations create stress and strain singularities. The fracture mechanics analyses concluded that the separation would not grow during storage and pressurization. Pressure was analyzed for two different temperatures at the propellant mean bulk temperatures (PMBT) of 40 °F and 90 °F. Four different scenarios were considered to determine the potential for separation growth:

- Two for growth in the aft and forward directions.
- One for growth in the terminus.
- One for growth in the extended terminus (assuming the terminus extended to the end of the separation).

The extended terminus had the lowest safety factor of 2.9, which was for storage conditions. Analysis of separation growth in the forward and aft directions revealed that growth in the forward direction had the lowest safety factor of 8.6 for storage.

As for potting the flap gap with adhesive to prevent hot gases from getting to the end of the terminus, the analyses showed that:

1) The flap gap would open sufficiently to pour an adhesive into the flap gap.
2) Potting would not significantly affect the stress in the segment.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The structural analyses performed on this separation indicates this segment would be marginal for any type of ignition. The inspection team (QA/NDE) would not guarantee that the separation does not connect with the propellant. Therefore, this segment should not be used in a RSRM flight and would be risky in a static test firing. Currently, this segment is being used in long term storage testing. The segment could also be used in the aging and surveillance program to obtain dissect samples.

4.0 DISCUSSION

4.1 Material Properties

The grain includes the viscoelastic materials of propellant, liner, castable inhibitor, and insulation (PLI^2). The mechanical properties of PLI^2 are load rate and temperature dependent. Proper selection of material properties allows the use of linear elastic and infinitesimal deformation theory solutions. The grain material properties are presented in "Mechanical Properties of SRM Propellant Grain Materials" (see Reference 1).

4.2 Analysis Loads

The loading conditions for the separation analyses are presented in the "RSRM Grain Loads Data Book" (see Reference 2), and summarized as follows:

1) STORAGE

   a) Insulation cool down from 300 °F to 135 °F.

   b) Propellant, liner, and insulation cool down from 135 °F to 40 °F PMBT.

   c) Horizontal Slump (1.0 gravity with case in a horizontal position).

   d) Vertical Slump (1.0 gravity with case in a vertical position).

2) LAUNCH

   a) Pressurization, maximum expected operating pressure (MEOP).

   b) Acceleration (0.6 gravity with case in a vertical position).

Thermal cool down from 300 °F to PMBT, and pressurization are the two major loading conditions. These loads were analyzed in each fracture mechanics analysis. The assumption was that this segment would only be used for a static test, therefore, vertical slump and acceleration loads were not considered. The horizontal slump load is an asymmetric loading condition, and the energy release rate will vary around the case. Therefore, the energy release rate for horizontal slump was calculated using the same formulas used in "RSRM Insulation/Case Unbond Structural Analysis", (see Reference 3). Horizontal slump is not normally a critical loading condition, therefore, it was considered only for the forward direction and extended terminus. These two separations had the greatest potential of growth during storage conditions.

4.3 Fracture Mechanics Analysis

Because of the stress and strain singularities present at separation terminations, the results of the finite element stress analyses cannot be used to assess the safety factor based on conventional stress or strain failure criteria. In these cases, fracture mechanic analysis must be used to calculate the corresponding energy release rates or stress intensity factors. The safety factor for the bondline is defined by either of the following:

1) the square root of the ratio of the critical energy release rate (G_c) to the induced energy release rate; or,

2) the ratio of the critical stress intensity factor to the calculated stress intensity factor.

In this analysis, the critical energy release rate method was used to assess the safety factor. For the purpose of obtaining a safety factor, the following G_c were used for nitrile butadiene rubber (NBR) cohesive bonds:

$$G_{c\ \text{Storage}} = 15.0 \ \frac{\text{lb-in.}}{\text{in.}^2}$$

$$G_{c\ \text{Pressure}} = 90 \ \frac{\text{lb-in.}}{\text{in.}^2}$$

The critical energy release rates are a result of the characterization of the PLI[2] that was part of the RSRM program. The critical energy release rate characterization is documented in TWR-18185 (see Reference 4).

4.3.1 Induced Energy Release Rate

The finite element code TASS was used to obtain the forces and displacements required to predict the induced energy release rate. G_i (induced energy release rate) is calculated using the following equation taken from Reference 4.

$$G_i = (P_T \Delta U_T + P_S \Delta U_S) / 2\Delta A \qquad \text{(Equation 1)}$$

where:

G_i = Induced energy release rate

P_T = Tensile force restricting crack growth

P_S = Shear force restricting crack growth

ΔU_T = Displacement in the crack with P_T removed

ΔU_S = Displacement in the crack with P_S removed

ΔA = Change of crack area

The forces are calculated in the first of two computer runs with the crack being at the initial size. In the second computer run the crack is allowed to propagate and the displacements of the nodes at the initial crack size are obtained (see Reference 4). These forces and displacements are then combined as the above equation indicates and yields the energy release rate for one loading condition. The induced energy release rate is a combination of more than one loading condition for both storage and pressurization.

4.3.2 Method of Combining Loads

To obtain the total induced energy release rate for two or more loads, the loads are combined as follows:

$$G_I = \frac{\Delta U_1 \ \Delta P1}{2\Delta A} + \frac{\Delta U2 \ \Delta P2}{2\Delta A} + \frac{\Delta P1 \ \Delta U2}{\Delta A} \quad \text{(Equation 2)}$$

where:

$\Delta U1$ = The crack opening displacement caused by one loading condition.

$\Delta U2$ = The crack opening displacement caused by a second loading load and/or subsequent loads.

$\Delta P1$ = The force restricting crack growth caused by one loading condition.

$\Delta P2$ = The force restricting crack growth caused by the second loading condition and/or subsequent loads.

ΔA = Change of the crack area.

The terms in Equation 2 are divided into the tensile and shear modes by using Equation 1 then summed as equation 2 indicates, thus, obtaining the total induced energy release rate for storage or pressurization loading conditions.

4.3.3 Geometry

A center segment model was modified with each of the separations analyzed. The models were axisymmetric assuming a full circumference separation. The analyses assumed the separation was between two plies of the insulation and that the separation terminus was at the tie ply (see Figure 1).

For pressurization loading, pressure is applied in the flap gap to the end of the terminus. In the case of the extended terminus, pressure is applied over the entire length of the extended terminus.

5.0 RESULTS

The main purpose of the fracture mechanics analyses was to predict the potential of the separation growth. The stress analysis was performed to determine if pouring adhesive in the flap gap would significantly affect stresses throughout the segment, and to determine if the flap gap would open enough to pour adhesive into it.

5.1 Fracture Mechanics

Four different separation tips were analyzed using fracture mechanics to predict G_i.

1) Separation growth in the forward direction.
2) Separation growth in the aft direction.
3) Terminus growth.
4) Growth of the extended terminus, assuming the terminus connected to the separation.

Figure 1 indicates the location where the separation is with respect to the segment. Figure 1 also shows the separation growth in the forward and aft directions, and the location of where the terminus growth was analyzed. Figure 2 shows the extended terminus separation. Figure 3 is the finite element grid used to analyze separation growth in the forward direction and the extended terminus (which is the same grid with a void between the flap gap and the separation). Figure 4 is the finite element grid used to perform analyses for separation growth in the aft direction. Figure 5 is the finite element grid used to perform the analyses for the flap gap terminus.

The results of these analyses are presented in Table 1. These results illustrate that the separation has a smaller potential for growth than the terminus. The major concern is the small possibility that the terminus connects to the separation because of an undetectable separation. In this case, the safety factor for separation growth drops from 3.4 for the terminus to 2.9 for the extended terminus for storage at a PMBT of 40 °F.

In Table 1, storage loads are the dominant loading conditions to propagate any separation. When a segment is pressurized, a separation in the insulation will experience a compressive force (assuming that hot gases cannot flow to the separation tip), which would reduce the potential for separation growth. If pressure were to flow to the tip of the separation in the extended terminus, the analysis shows that the extended terminus would not continue to grow, therefore, the segment in question could be used in a static test.

TABLE 1

Results of Fracture Mechanics Analyses

Induced Energy Release Rate for Separation lb-in./in.^{2}

Loading Condition	Aft	Forward	Terminus	Extended Terminus
Thermal Cool down 300 °F to 135 °F	0.035	0.096	0.070	0.141
135 °F to 40 °F	0.092	0.060	1.200	1.530
Horizontal Slump		0.045		0.129
Total Storage	0.127	0.201	1.270	1.797
Safety Factors	10.9	8.6	3.4	2.9
Pressurization PMBT 40 °F	0.112	0.127	0.116	0.781
Safety Factor	19	17	8.1	5.9
PMBT 90 °F	0.004	0.000	0.002	0.034
Safety Factor	26	21	8.4	7.0

Allowable NBR Cohesive Energy Release Rates

$$G_c \text{ Storage} = 15.0 \ \frac{\text{lb-in.}}{\text{in.}^2}$$

$$G_c \text{ Pressure} = 90 \ \frac{\text{lb-in.}}{\text{in.}^2}$$

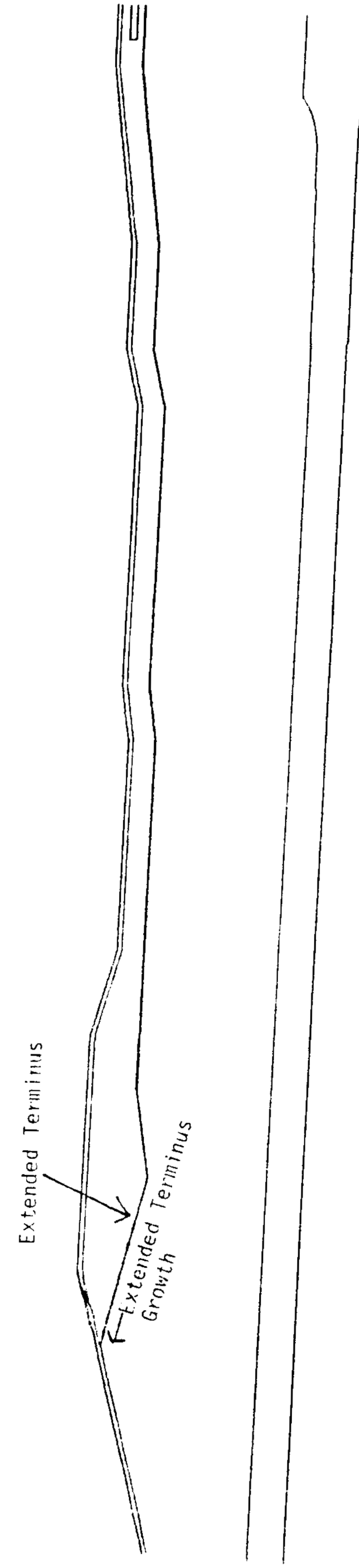


Figure 2
Flapbulb With the Position of the Extended Terminus

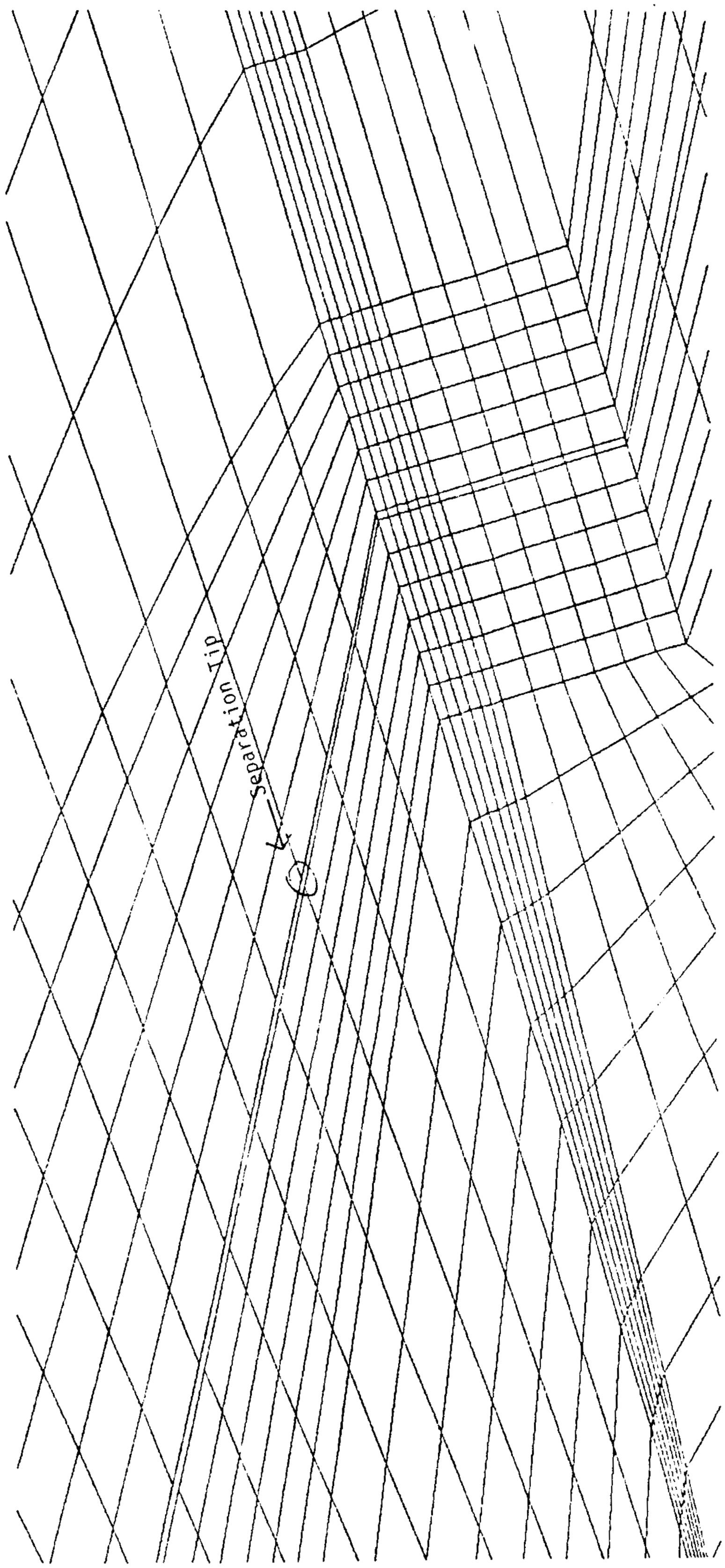


Figure 3
Finite Element for the Forward and Extended Terminus Separation Growth

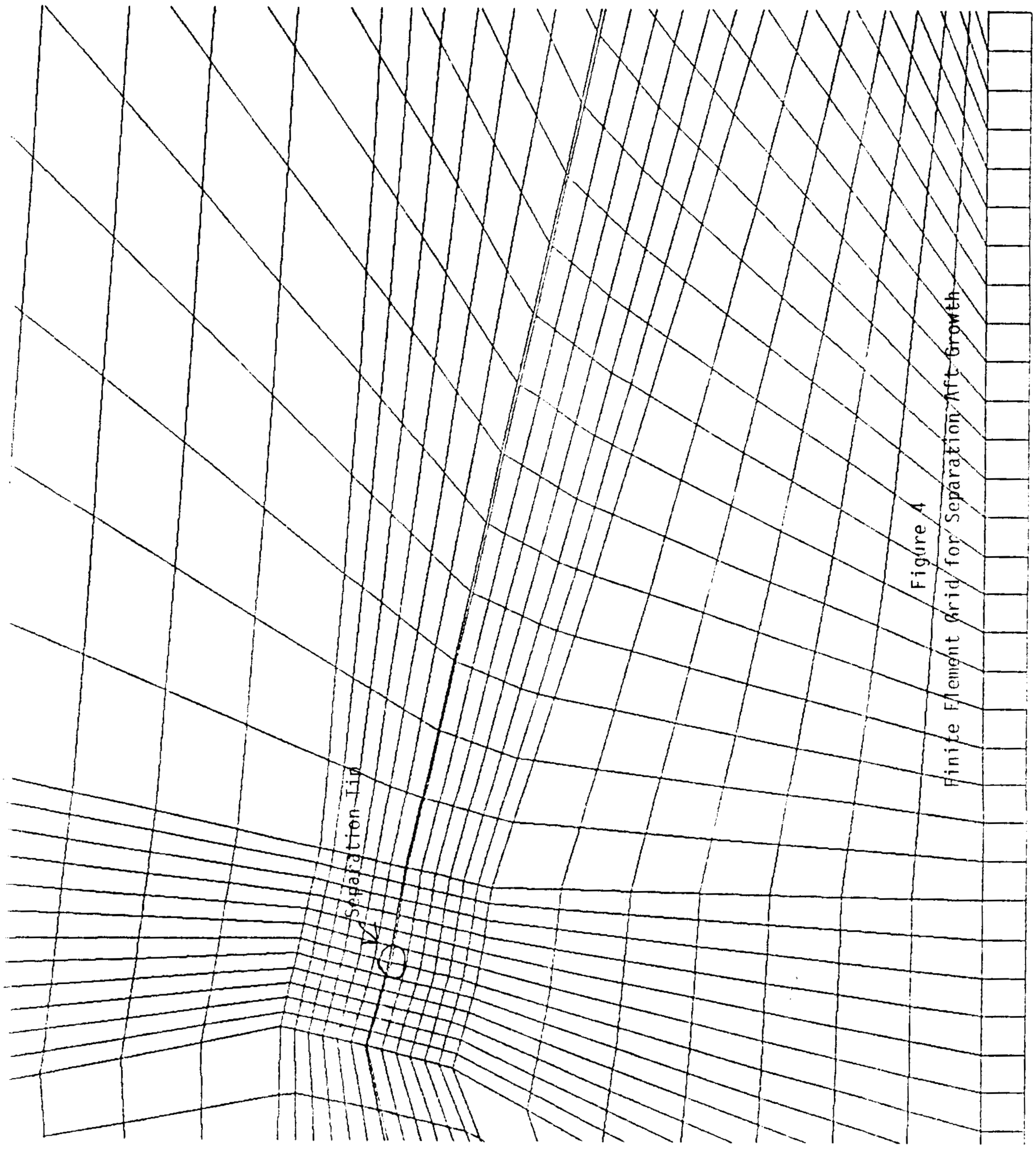


Figure 4
Finite Element Grid for Separation Aft Growth

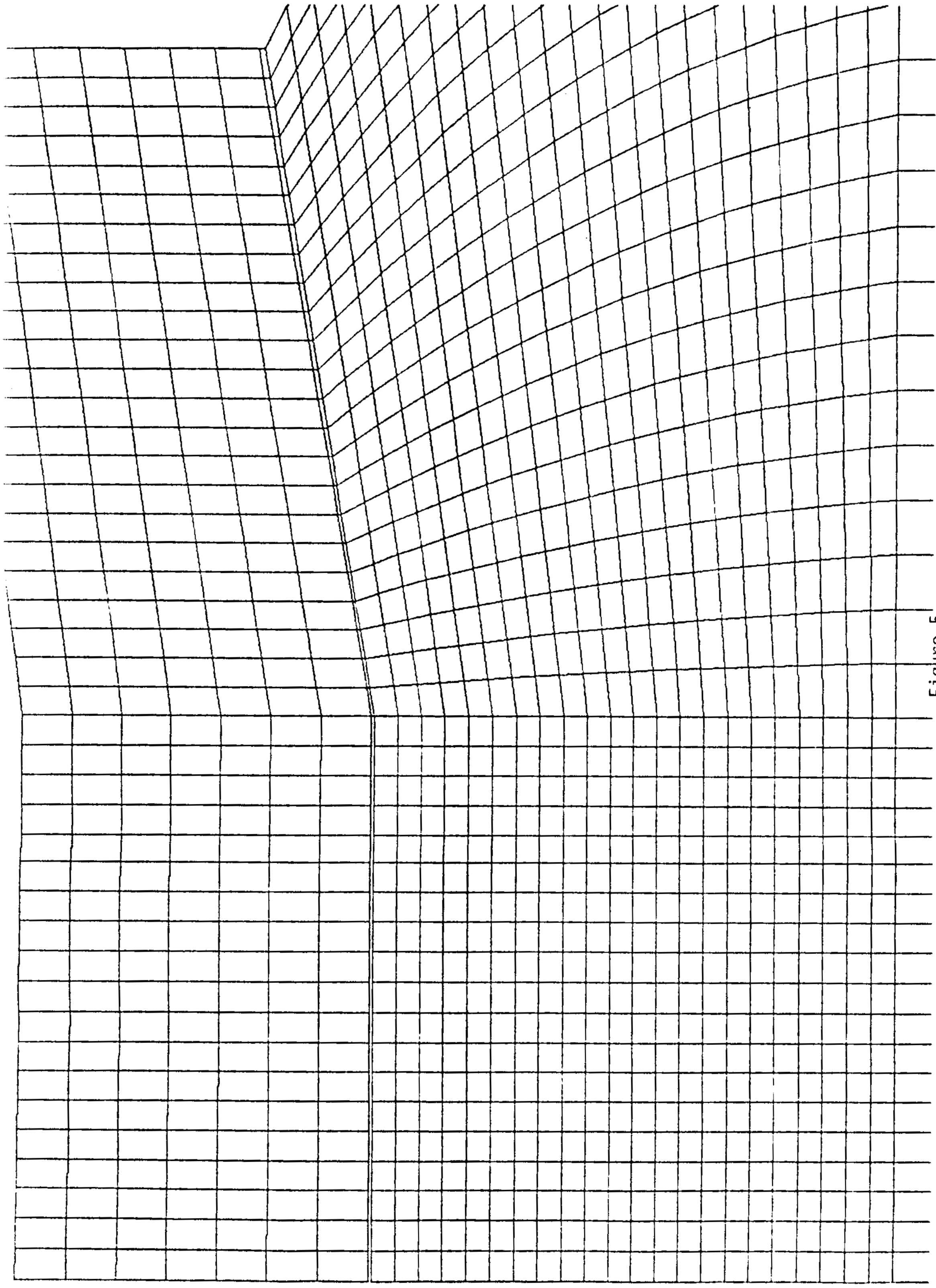


Figure 5
Finite Element Grid for Terminus Growth

5.2 Stress Analyses

To use the segment under scrutiny in a static test, the flap gap could be filled with some adhesive to prevent hot gases from flowing to the end of the terminus and the end of the separation, if the terminus and separation are connected. If the flap gap is filled with an adhesive, several issues must be addressed.

1) What adhesive would fill the flap gap and provide a good bond to the insulation?
2) Does the flap gap open far enough in the vertical position to pour in an adhesive?
3) How should the insulation in the flap gap be etched to provide a good bond to the adhesive?
4) Could the insulation be hand etched in the horizontal position?
5) Would an adhesive adversely affect the performance of the segment?
6) What bond length would be needed to prevent hot gas flow to the terminus when the segment is pressurized?

Many different finite element analyses were completed to determine the answers to these questions. Conclusions from these analyses, and information from experts concerning these various subjects are summarized as follows:

1) Polysulfide would be the most probable adhesive used with RP-6401 in the first few inches in front of the terminus.
2) The flap gap opens about 0.5 inch when the segment is in the vertical position.

3) There are two possible ways to etch the flap gap insulation: by hand or chemically.

4) In the horizontal position, the flap gap opens about 0.75 inch at the top center position. The opening of the flap gap is opened about 0.5 inch, 6 inches back, therefore, hand etching would be possible. Since the Propellant and Adhesive Structures Section is not qualified to address the concerns of chemical etching, this type of etching is not discussed in the present document.

5) The analyses showed that with adhesive in the flap gap, the stresses during pressurization would decrease less than 5 percent. Since the stress is compressive, there would not be any adverse effect to the structural integrity of the segment.

6) Since the segment is in compression during pressurization, the only load an adhesive would have to carry is the pressure in front of the flap gap before the pressure is equalized in the segment. To carry this load, a bond at least 0.5 inch long is needed.

6.0 REFERENCES

1. Gutierrez-Lemini, D., and Regal, R. R., TWR-18011, Supplement B, Revision A, "RSRM Structural Material Properties Data Book, Propellant, Liner, Insulation, and Inhibitor", Morton Thiokol, Inc., 2 August 1988.

2. Clark, L. M., TWR-16948, Revision A, "Loads for Use in PLI^2 Structural Analysis", Morton Thiokol, Inc., 1 August 1988.

3. Nelson, B. F., Downey, P. J., and Clark, L. M., TWR-17038, Revision B, "RSRM Insulation-to-Case Unbond Structural Analysis", Morton Thiokol, Inc., 29 July 1988.

4. Farahyar, J., TWR-18185, "Fracture Toughness Characterization of Adhesive and Cohesive NBR", Morton Thiokol, Inc., April 1988.

5. Farahyar, J., TWR-16842, "Modeling Procedure for Finding Energy Release Rate Using Crack Closure Integral Method", Morton Thiokol, Inc., June 1987.

APPENDIX A

Discrepancy Report No. 123552

DISCREPANCY REPORT

TOTAL SHEETS: 1 X, 2 X, 3 X, 4 X, 5 X, 6 X

☒ TC NON CON MATL / CUST/GOVT FURN ITEM ☐ VENDOR NON CON MATL / PROCESS DEPARTURE

No 123522

1. PROGRAM: Space Shuttle
2. PROGRAM CODE: FE
4. PROJECT NO: 4E20?
5. ORDER NO: 4E41C 00 0001
6. COMPONENT CODE: WNB
7. ASSEMBLY PART NO: 1U-75427-03(903) REV N/C
8. ASSEMBLY SERIAL NO: 0000001
9. NAME OF ASSEMBLY: CTR Casting Seg X-Ray
10. VENDOR NAME: N/A
11. VENDOR CODE: N/A
12. DISCREPANT PART NO: 1U-75427-03(903) REV N/C
13. DISCREPANT SERIAL NO: 0000001
14. NAME OF DISCREPANT PART: CTR Casting Seg X-Ray
15. RECEIVING REPORT NO: N/A
16. PURCHASE ORDER CONTRACT NO: N/A

17. TOTAL DR ITEMS	18. TOTAL NO INSP	U/M	19. TOTAL NO DISCREPANT	20. BLDG NO.	21. MRB HOLD AREA	22. IP REV	22A. ITEM NO.	22B. MULT	22C. OCD NO	22D. IP TYPE	22E. CAT	22F. CLIFS	22G. CPI NO.	22H. REV	22I. OP NO	22J. STEP NO	22K. REUSE (SRM)	22L. REFURB (SRM)
	1	ea	one	M39	M-39	N/A	N/A	N/A	N/A	P	N/A	N/A	4E41C	CC	010	480	N/A	N/A

23. ITEM NO	24. QUANTITY	25. FREQ	26. ACCEPTED UNITS	27. REFERENCE DOCUMENT
01	1	0	N/A	STW7-2831 PARA 5.3 Table III Condition B

UC1

DESCRIPTION

28. Should Be: Insulation to Insulation unbonds, None allowed in First 40 inches inboard from tang end.
Condition is: Insulation to Insulation unbonds within 40 inches of the tang end. There are Five (5) unbonds located at the following degrees 210° 297° 315° 321° 359° locations and dimensions on continuation sheets

29. INITIATOR	COST CENTER	TIME	DATE	30. SUPERVISOR APPROVAL	TIME	DATE	31. CUSTOMER ACKNOWLEDGEMENT	TIME	DATE
Jeffrey A Fisher	9225	1830	11 3 87	[illegible signature]	1855	11 3 87	[illegible signature]	1043	11 ? ??

PRIORITY NO: 1 BY: KA

CAUSE

32.

33. CAUSE CODE

34. RESP C.C

CORRECTIVE ACTION

35.

36. CA DETERMINED BY | COST CENTER | DATE MO DA YR | 37. EFFECTIVITY SERIAL NO. | 38. EFFECTIVITY DATE | 39. CAR NO.

MO DA YR: 11-4-87

DISPOSITION

40. ITEM NO.: 01 | 41. QUANTITY | 42. DISP CODE

43. FINAL/MOST SEVERE DISPOSITION

44. MR1 - Position the discrepant area ... the upper quadrant for a minimum of ... hours ... inspection after the 7 hour time taken ... extent of the discrepancy.

11-4-87 12:00

55. SCHEDULE NEED DATE

45. CUST/GOVT WAIVER ☐ YES ☐ NO
46. CLIFS AFFECTED ☐ YES ☐ NO
47. END CATEGORY
48. ☐ PD ☐ PMR ☐ MRB
49. TC ENGR APPROVAL DATE
50. TC QA APPROVAL DATE
51. CUSTOMER APPROVAL DATE
52. GOVT APPROVAL DATE
53. DR RELEASED BY
54. DISPOSITION COMPLETE

FORM TC 1890 (REV 6-82)

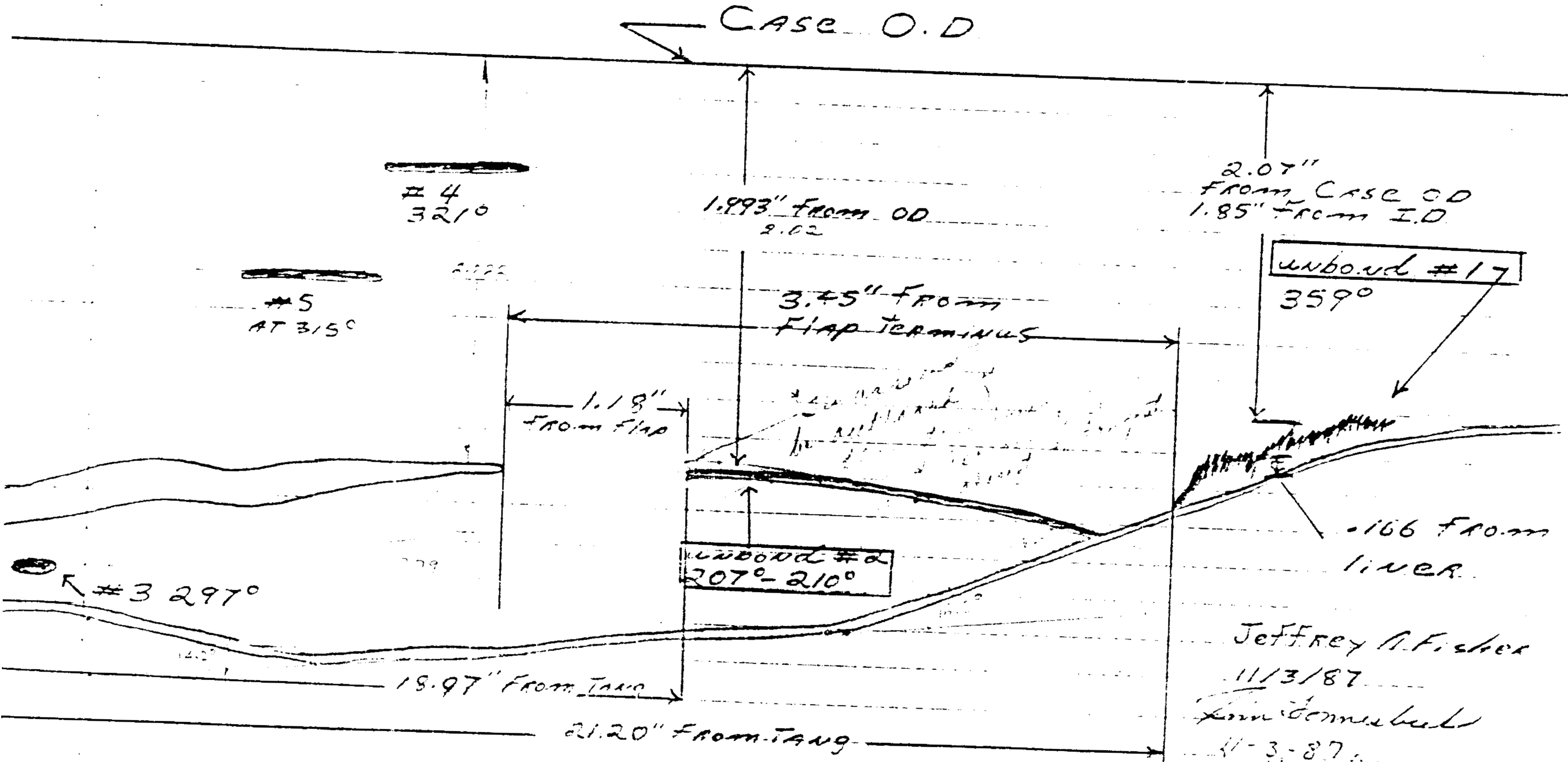
THIS APPROVAL DOES NOT CONSTITUTE A WAIVER BY THE GOVERNMENT OF ANY CLAIM FOR EQUITABLE PRICE ADJUSTMENT AS THE CONTRACTING OFFICER MAY DEEM APPROPRIATE BECAUSE OF SUCH WAIVER. THIS DISPOSITION DOES NOT ESTABLISH PRECEDENT FOR FUTURE ...

No 123522

DISCREPANCY REPORT (GENERAL PURPOSE CONTINUATION)

MORTON THIOKOL, INC.
Wasatch Operations
P.O. Box 524, Brigham City, Utah 84302 801 863-3511

PROGRAM NAME	DISCREPANCY PART NO.	REV	DISCREPANT PART SER NO.	NAME OF DISCREPANT PART	PAGE 2 OF
SPACE SHUTTLE	1U-75427-03(903)	N/C	0000001	CTR CASTING SEG X-RAY	DR NO. 123522
BLOCK NO. / ITEM NO.					



Jeffrey A. Fisher
11/3/87
11-3-87
11-3-87

FORM TC 1990 (PART II) (REV 2-85)

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123522

SCREPANCY REPORT (GENERAL PURPOSE CONTINUATION)

MORTON THIOKOL, INC
Wasatch Operations
PO Box 524 Brigham City Utah 84302 801 863 3511

PAGE 3 OF

RAM NAME	DISCREPANCY PART NO	REV	DISCREPANT PART SER NO	NAME OF DISCREPANT PART	DR NO
PACE SHUTTLE	1U75427-03 (903	N/C	0000001	CTR CASTING SEG X-RAY	123522

OCK NO. | ITEM NO.

REE	#	CIR. EXTENT	LONGITUDINAL	RADIAL	FROM CASE O.D.	FROM LINER	TOTAL INSULATION	FROM TANG END	FROM FLAP GAP TERMINUS
9°	1	3.65"	1.615"	.100"	2.07"	OPEN TO LINER	1.736"	21.20"	3.45" FWD OF
0°	2	7.33"	2.563"	.049"	1.993"	OPEN TO LINER	3.02"	18.07"	1.18" FWD OF
7°	3	7.25"	.054"	.055"	2.8"	.152"	2.43"	15.245"	2.51" AFT OF
1°	4	3.71"	.853"	.061"	1.053"	1.82"	2.768"	14.663"	2.283" AFT OF
5°	5	3.686"	.700"	.053"	1.55"	1.365"	2.89"	14.54"	2.06 AFT OF

Jeffrey A. Fisher
11/3/87
Jim Lamschek
11-3-87
Bradley H. Cifuentes
11-3-87

DISCREPANCY REPORT (CONTINUATION SHEET) RSRM - 1A

MORTON THIOKOL INC
WASATCH DIVISION

PROGRAM	2. DISCREPANT PART NO.	REV	3. DISCREPANT SERIAL NO.	4. NAME OF DISCREPANT PART	5. PAGE
SPACE SHUTTLE	1U-75427-03(903)	N/C	0000001	CTR CASTING SEG X-RAY	4 OF

COMPONENT CODE	7. IP REV	7A. IP ITEM NO.	7B. MULT	7C. OCD NO.	7D. IP TYPE	7E. CAT	7F. CLIFS	7G. CPI NO.	7H. REV	7I. OP. NO.	7J. STEP NO.	7K. REUSE (SRM)	7L. REFURB (SRM)	
WNB	N/A	~~N/A~~	N/A	N/A	P	N/A	N/A	4B41C	00	010	480	N/A	N/A	DR 123522

8. ITEM NO	9. QUANTITY	10. FREQ	11. ACCEPTED UNITS	12. REFERENCE DOCUMENT	
2	1	0	N/A	Per Print # 1U-75427-03	LC

13. Should Be: No low density Indications allowed at Insulation To liner interface area.
Is: A low density indication that extends radial into the insulation from the liner located at 138° maximum dimensions check→ .025" long, .156" radial and 3.58" cir see continuation sheet for locations.

INITIATOR	COST CENTER	TIME	DATE MO DA YR	15. SUPERVISOR APPROVAL	TIME	DATE MO DA YR	16. CUSTOMER ACKNOWLEDGEMENT	TIME	DATE MO DA YR
Jeffrey A Esker	8225	1830	11 3 87	Jim [illegible]	1835	11 3 87	Bradley [illegible]	1843	11 3 87

17.

18. CAUSE CODE

19. RESP C C

PRIORITY NO. BY

20.

SCEDS DEF PARA ________ HC ________ DC ________
DR ________ FCI ________ MS ________
MOTOR NO. ________ RETEST ____
CRITERIA ________

MO DA YR

21. CA DETERMINED BY	COST CENTER	DATE MO DA YR	22. EFFECTIVITY SERIAL NO.	23. EFFECTIVITY DATE MO DA YR	24. CAR NO

25. ITEM NO.	26. QUANTITY	27. DISP CODE	28

39. SCHEDULED NEED DATE

29. CUST GOVT WAIVER ☐ YES ☐ NO
30. CLIFS AFFECTED ☐ YES ☐ NO
31. END CATEGORY
32. ☐ PD ☐ PMR ☐ MRB
33. TC ENGR APPROVAL DATE
34. TC QA APPROVAL DATE
35. CUSTOMER APPROVAL DATE
36. GOVT APPROVAL DATE
37. DR RELEASED BY MO DA YR
38. DISPOSITION COMPLETE MO DA YR

[illegible] (CONTINUATION) [illegible]

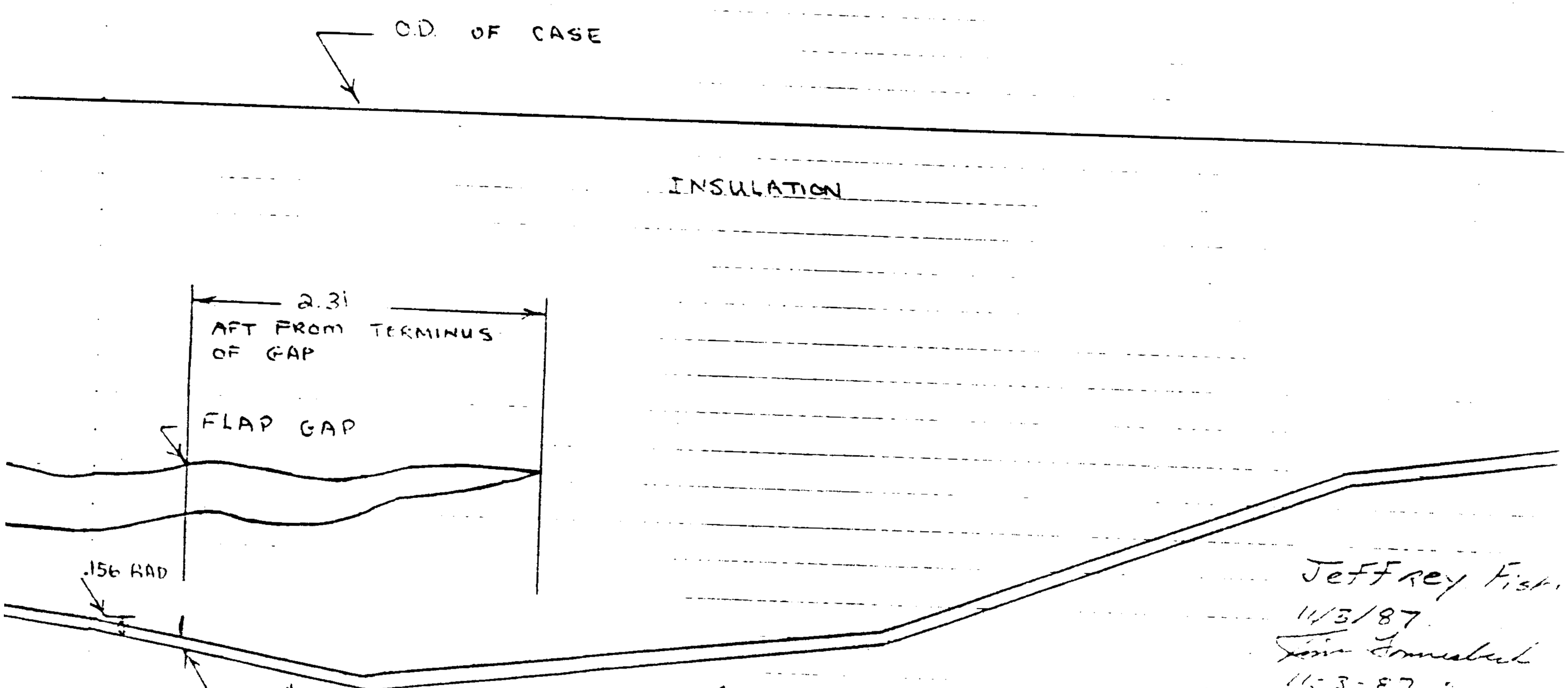
THE [illegible] DOES NOT CONSTITUTE A WAIVER BY THE GOVERNMENT OF ANY CLAIM FOR EQUITABLE PRICE ADJUSTMENT AS THE CONTRACTING OFFICER [illegible] APPROPRIATE BECAUSE OF SUCH WAIVER. THIS DISPOSITION DOES NOT ESTABLISH PRECEDENT FOR FUTURE DISPOSITIONS.

MORTON THIOKOL, INC. RSRM 1A
Wasatch Operations
P.O. Box 524 Brigham City, Utah 84302 801 863 2511

DISCREPANCY REPORT (GENERAL PURPOSE CONTINUATION)

PROGRAM NAME	DISCREPANCY PART NO.	REV	DISCREPANT PART SER NO.	NAME OF DISCREPANT PART	PAGE 5 OF
SPACE SHUTTLE	1U75427-03 (903	NC	0000001	CENTER CASTING SEGMENT	DR NO. 123522

BLOCK NO.	ITEM NO.
13	02



.035" LONG AND 3.58" CIR. And 15.44" From the tang end.

Jeffrey Fish
11/3/87
[signature]
11-3-87
[signature]
11-3-87

FORM TC 1890 (PART I) (REV 2-85)

THIS APPROVAL DOES NOT CONSTITUTE A WAIVER BY THE GOVERNMENT OF ANY CLAIM FOR EQUITABLE PRICE ADJUSTMENT AS THE CONTRACTING OFFICER MAY DEEM APPROPRIATE BECAUSE OF SUCH WAIVER. THIS DISPOSITION DOES NOT ESTABLISH PRECEDENT FOR FUTURE DISPOSITIONS.

DR 123522

DISCREPANCY REPORT (GENERAL PURPOSE CONTINUATION)

MORTON THIOKOL, INC
Wasatch Operations
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PROGRAM NAME	DISCREPANCY PART NO.	REV	DISCREPANT PART SER NO.	NAME OF DISCREPANT PART	DR NO
Space Shuttle	1U75427-03(903)	N/C	0000001	CTR. Casting Seg. X-Ray	123522

BLOCK NO.	ITEM NO.
28	C1

X-Ray results per M.R.I. Cat I:

Defect at position no. 2: X-Ray was accomplished by placing Beam centerline at forward end of defect and aft end of defect to produce as true as geometry as possible.

Exposures were made in order to show defect extent while on tangent to the beam centerline and to show any change in extent after positioning defect at top dead center for 8 hours.

Data: Beam center at 303" longitudinal position.

Degree	longitudinal	radial	Dist. from Case O.D.
303°	'Defect off tangent'		
305°	2.33"	.045"	1.99"
307°	2.43"	.033"	2.01
309°	2.38"	.060"	2.06"
311°	'Defect off tangent'		
	Beam center at 300.5" longitudinal position.		
303°	'Defect off tangent'		
305°	2.42"	.048"	2.04"
307°	2.35"	.055"	2.06"
309°	'Defect off tangent'		
311°	* 'Defect off tangent'		

Note: There appears to be no significant change in defect size from previous X-ray.

* With beam centerline at extreme forward (ie, 300.5") end of defect, it appears that circumferential extent is less.

Farren Spaulding 2134 hrs
5 NOV 87

Frank Flint 2135 hrs
5 NOV 1987

123522